THE IMPACTOR FLUX IN THE PLUTO-CHARON SYSTEM

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The impactor flux on Pluto and Charon consists of long-period comets from the Oort cloud passing through the region, and intermediate-period comets evolving inward to (or outward from) short-period orbits. The source of the intermediate-period comets is likely an extended disk of remnant planetesimals beyond the orbit of Neptune, commonly referred to as the Kuiper belt (Duncan et al. 1988), though the Oort cloud may be an additional source of some short-period comets. The Pluto-Charon system actually circulates within the Kuiper belt, and with an aphelion of 49.3 AU, moves through a region where remnant planetesimal orbits would likely be stable over the age of the solar system (Levison and Duncan, 1993). The recent discovery of two objects at Kuiper belt distances, 1992 QB_1 and 1993 FW (Jewitt and Luu, 1992; Luu and Jewitt, 1993), and the fact that the orbit determined for 1992 QB_1 is likely of low eccentricity and low inclination (Marsden, 1992), have provided strong observational evidence for the Kuiper belt.

Weissman et al. (1989) showed that, for the expected number of objects in the Kuiper belt necessary to provide the short-period comet flux, cometary cratering on Pluto and Charon is dominated by Kuiper belt comets. Using the Kuiper belt orbit distribution suggested by Duncan et al. (1988), Weissman et al. found mean impact probabilities per perihelion passages of 8.9 x 10-14 and 1.9 x 10-]4 for Pluto and Charon, respectively, Assuming a Kuiper belt population of 4 x 10* objects with absolute magnitudes brighter than $H_{10} = 11$ (masses > 4 x 10'5 g), the resulting impact rates were 1.5 x 10^{-7} and 3.2x 10^{-8} year^{-1}, for Pluto and Charon respectively. Mean impact velocities were 2.3 km see-l for Pluto, and about 3% less for Charon. For comparison, long-period comets had mean impact probabilities per perihelion passage of 5.3 x 10-14 and 1.4 x 10-14, and impact rates of 5.6 x 10^{-11} and 1.5 x 10^{-11} year^{-1}, for Pluto and Charon, respectively. The rms impact velocity for the long-period comets was 8.2 km see-l for Pluto, and are identical to within 1 % for Charon if one ignored Charon's orbital velocity, which is only 0.21 km see-l.

We will provide updated estimates of these numbers, based on an improved understanding of Oort cloud and Kuiper belt dynamics since 1989, and on improved estimates for the radii and masses of Pluto and Charon.

Because Pluto and Charon actually penetrate the stable region of the Kuiper belt beyond 40 AU, expected cratering rates for the pair are substantially higher than for Triton, which is located at the inner edge of the Kuiper belt. However, the Pluto-Charon system is tidally evolved and this may have led to resurfacing events at various times in its history. Thus, detailed predictions of the integrated crater density or comparisons with Triton are not very meaningful without a knowledge of that history. Differences in the suspected compositions of Pluto and Charon may also lead to different surface theologies and thus, different retention times for cratered surfaces.

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